

Popularization of Himalayan *Berberis* species as a source of nutraceuticals

Nutraceuticals are defined as any non-toxic food extract supplements that have scientifically proven health benefits for both disease treatment and prevention¹. Recently, nutraceuticals have spawned considerable interest because of their presumed nutritional value and their importance in curing cancer, obesity, diabetes, heart disease as well as Parkinson's and Alzheimer's diseases². The global market for nutraceuticals is large with high annual growth rate. Nutraceutical and functional food is a multi-billion dollar industry with projected sales for 2010 being estimated to reach between US\$ 167 billion and US\$ 187 billion³. The nutraceutical industry, therefore, has a potential of providing opportunities for economic growth.

There are several issues like increasing population, shortage of cultivable fertile land, inflation in food prices and restriction on import of food that have led to food crisis in the developing countries, including India⁴. In this scenario, wild edible plants have rejuvenated interest among researchers to explore their nutrient content and medicinal value. It is often seen that the nutritional value of wild edible plants is higher than several known common vegetables and fruits⁵. However, most of them remain underutilized despite having potential food value.

To illustrate this further, Uttarakhand Himalaya has a large variety of wild edible plants. Despite abundant wild edible plant resources with immense potential for economic development, the region remains less explored. For example, genus *Berberis*, has recently attracted interest mainly for its medicinal properties and nutritional value. In Uttarakhand Himalaya, use of *Berberis* species is restricted to local communities. The ripe

fruits are eaten or consumed in the form of chutney and juice. The locals also use it for bio-fencing and as an agricultural tool (pers. obs.).

The plant contains many nutrients and bioactive compounds like anthocyanins, β -carotene, ascorbic acid and essential minerals. It has been studied (whole including fruits) chemically and biologically for the presence of alkaloids. Parts of the plant like roots and stems are well known for their medicinal properties. For example, fresh roots are used for curing diabetes and jaundice⁶. The stems are recommended in rheumatism and the roots are reported to possess anti-cancer activity. The berries are mildly laxative and are given to children⁷.

On the nutritional front, seeds and pulp of *Berberis* species like *B. asiatica*, *B. aristata*, *B. lycium*, *B. jaeschkeana* and *B. pseudumbellata* are a good source of proteins, carbohydrates, fat, energy, vitamins and minerals like iron, cobalt, copper and calcium⁸. Juice from *B. lycium* contains considerable amount of anthocyanin⁹. Considering the nutrient value and medicinal properties of *Berberis* sp., it could be considered an important nutraceutical.

Therefore, we attempt to draw attention of researchers, local communities and government agencies to consider *Berberis* as an essential nutraceutical. Though *Berberis* species has been reported as a potential nutraceutical source, a systematic study of the nutritional attributes of Himalayan *Berberis* may help the nutraceutical industry to explore it further. There is also a need to collate available information on the availability, distribution and nutrient content of this species growing in different agro-ecological regions. A focused

research approach to document and evaluate the indigenous knowledge, diversity and cultural significance of *Berberis* species is required.

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The mortality of banj oak (*Quercus leucotrichophora* A. Camus) trees in Mussoorie, Uttarakhand: is it an alarming call for rapid degradation?

The Himalayan region is represented by 35 species of oak (*Quercus* spp.) distributed between 1000 and 3600 m amsl. Of these, five species are found in the state

of Uttarakhand, namely *Q. glauca* (phaliyant/harinj), *Q. leucotrichophora* (banj), *Q. floribunda* (tilonj/moru), *Q. lanuginosa* (rianj) and *Q. semecarpifolia*

(kharsu). Of the various species of oak, the white oak or banj was reported to be forming extensive belts along the middle elevation (1000–2500 m) zone of Western

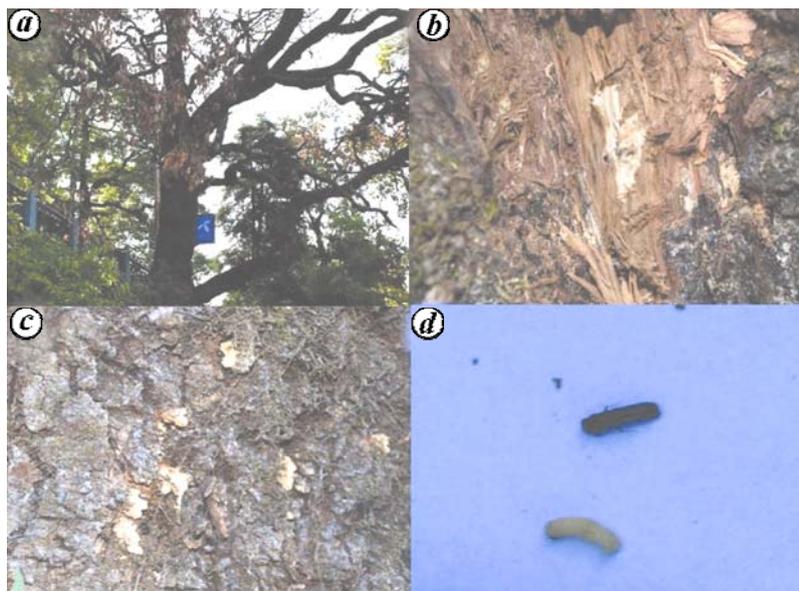


Figure 1. a, An affected banj oak tree; b, c, infected bark and d, Beetle reported on the tree.

Himalaya. Banj oak is most abundant and widespread around 2000 m and less, where it exhibits 80% dominance (based on relative basal area); between 2000 and 2500 m, it may be co-dominant with *Q. floribunda*, above which it generally disappears¹. Banj oak is an ecologically, socially and economically important tree species. It provides fuelwood, fodder and timber and plays a vital role in conservation of soil from erosion and landslide, regulating water flow in watersheds and maintaining water quality in streams and rivers, and support high native floral and faunal diversity, thereby providing numerous ecosystem services to mankind in the region.

During the assessment of banj oak forests in Uttarakhand in 2010–11, mortality of some of banj oak trees in Mussoorie region (Lesser Himalaya range) was observed and a survey was made to assess the cause of mortality. The climate falls under cool temperate and the area receives snowfall mainly during mid-December to March. Most of the area comes under private estate at an elevation of 2000 m amsl. The area consists of dense, gregarious banj oak forest with some scattered deodar patches on the ridges. The dominant tree species in the area are *Q. leucotrichophora* with *Rhododendron arboreum* and *Cedrus deodara*. The dominant understorey shrubs are *Coriaria nepalensis*, *Daphne papyracea*, *Sarcococca saligna* and *Mahonia nepalensis*.

The affected area is under complete protection by the owner of the private estate and the State Forest Department. According to local residents, since last year few trees having more than 150 cm of girth class are shedding their leaves in March–April, which is unusual for an evergreen species. Such infected trees were examined and found to be attacked by a stem borer (beetle; Figure 1). The excreta of these beetles was observed around the infected trees in the form of small heaps of wood dust at the base of trees. Penetration of the conductive tissue by the pest resulted in the wilting of leaves and dieback of canopy branches of the trees, which severely affected photosynthesis in these trees. More than 50 trees were found dead in the entire Mussoorie region, ranging between 38 and 150 cm GBH (girth at breast height). Five to six trees were found near Padmini Niwash and Church on Mall Road, and the rest were on the way to Jharipani from Mussoorie.

Periodic decline and death of oaks have been recorded in several parts of the world since 1900. During the last century, symptoms of wilting in plants of *Rhododendron* and *Viburnum* were often observed in tree nurseries of Germany and The Netherlands². A new fatal phenomenon in several oak species was also recorded in USA during the same period, named as sudden oak death, oak decline, oak dieback or oak mortality and caused by a complex interaction of environ-

mental stresses and pests. The initiating factors associated with oak decline are drought, frost injury or insect defoliation.

It is well known that the Himalayan banj oak forests serve as the lifeline for the local inhabitants of the hilly region, who are heavily dependent on these forests for their day-to-day requirements. Several gentle slopes in this belt, which were originally under banj oak forest, have largely been transformed into cultivation or habitation, being replaced by more aggressive alien species. The remaining patches of oak forests continue to face chronic stress in the form of livestock grazing, lopping, extraction of fuelwood and various other biotic pressures. It may be predicted that some climatic conditions (relative humidity, air temperature and snowfall patterns) in the area are becoming favourable for the survival of these pest species. Similar climatic conditions in the future may result in the outbreak of disease in the oak unless mitigation strategies are developed. The mortality of this species is a matter of great concern which needs proper monitoring and research to find out the actual cause of the problem and also develop mitigation strategies to prevent the loss of the Himalayan legacy of oak forests.

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ACKNOWLEDGEMENTS. We thank the Uttarakhand State Council for Science and Technology for financial support.

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